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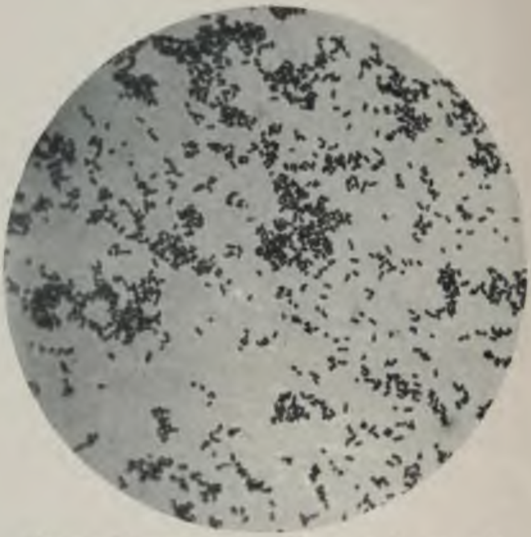

Micro-photograph of a colony of Bacillus Acidi Lactici. x 1,000.

THE DIAGNOSIS OF
CANCER OF THE STOMACH
IN ITS EARLY STAGE

BY

GEORGE HERSCHELL, M.D. LOND.
FELLOW OF THE ROYAL MEDICO-CHIRURGICAL SOCIETY

BEING THE

AUTHOR'S PRESIDENTIAL ADDRESS
TO THE WEST KENT MEDICO-
CHIRURGICAL SOCIETY IN 1903

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PREFACE

THE object and aim of this paper is to discuss briefly the diagnosis of cancer of the stomach before it has advanced so far as to be unmistakable, when there is yet probably no tumour to be made out by the ordinary methods of examination, and when the cachexia and anæmia are not yet so marked as to point to the presence of a serious affection.

It is a fact to be regretted that the unfortunate patient suffering from cancer of the stomach is usually treated for indigestion, dyspepsia, or for catarrh of the stomach until long after the stage when a radical means of cure could be employed with any probability of success.

I propose as well as I am able to attempt to systematise the present state of knowledge upon the subject and to point out how far the more modern methods of clinical research may help us in the task of unravelling the clinical problems which daily come to us for solution.

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And my remarks will be chiefly addressed to those engaged in general practice, as it is by these gentlemen that the discovery of cancer of the stomach must be made, if the diagnosis is to be made sufficiently early to be of benefit to the patient.

GEORGE HERSCHELL.

36, Harley Street, W.
July, 1903.

SYMPTOMS OF COMMENCING CANCER OF THE STOMACH

One of the best descriptions of the ordinary onset of cancer of the stomach is that given by Bouveret,* of which the following is a translation:—

"The patient is usually from 50 to 60 years of age. Until the present time he has not suffered from any gastric trouble of any duration. Without any known cause he commences to lose his appetite and to feel uneasy after his meals, to the extent of a sensation of weight and fulness at the pit of the stomach accompanied by a certain degree of nausea and flatulent eructations. To these stomach troubles is now added a marked tendency to constipation. The condition of the patient does not appear to be alarming, but nothing does him any good. At the end of a few months the patient and his friends commence to become alarmed, as he is getting weaker every day, and has already lost a certain amount of weight. The loss of appetite now increases, and may reach an absolute disgust for meat. He will now occasionally bring up a few mouthfuls of food in the middle or at the end of the digestive period. Usually during these first months the result of the examination of the stomach will be negative, and there is no tumour. The patient continues to lose flesh in spite of all treatment, and the complexion assumes a pale yellowish tint which is very characteristic. One cannot longer doubt the gravity of the affection. The patient tries in vain to awake his lost appetite. He commences to suffer more severely, and the vomiting becomes more frequent, especially if the tumour occupies the pylorus. The vomit contains alimentary debris, and if the patient has managed to swallow a little meat it will be returned absolutely unacted on by the gastric juice."

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* Bouveret, "Traité des Maladies d l'Estomac," Paris, 1892, p. 507.

With the exception of anorexia there is no symptom which appears to be especially characteristic of cancer of the stomach in its earlier stage. And it is easy to see why this should be the case, as in cancer we may have either orifice invaded, or infiltration of any part of the wall. Thus as we have interference with the motility, either partial or general, alteration in the secretions or irritation of nerves, so we shall have symptoms widely varying in character.

Loss of appetite amounting to absolute repugnance for food, especially meat, is met with in so many cases of malignant disease of the stomach that we are warranted in regarding it as a very suspicious sign, especially when associated with loss of weight and when occurring in a man over middle age who has hitherto had a sound and healthy stomach.

Such is a very usual course for the disease to take, and the problem is to diagnose it in the early stage when the patient was supposed to be suffering from indigestion only.

We will first of all see what information we can derive from a study of the symptoms present in any given case, and then discuss how much we may learn from an examination of the stomach itself.

We are always taught that cancer of the stomach is an affection of advanced life. Such is the case undoubtedly in many instances, but we must be on our guard not to allow ourselves to be unduly biassed by this and to dismiss the idea of cancer of the stomach in comparatively young subjects. We should bear in mind that out of 150 cases reported by Cheney, twenty were in subjects under 30, and seventeen between 30 and 40, and that Osler and McCrae also report six cases in patients under 30 years of age. Such cases occurring in young people are apparently unusually rapid in their course, and, it is needless to say, frequently overlooked and unrecognised.

There is no invariable peculiarity about commencing cancer of the stomach which will help us in the diagnosis.

It may come on suddenly or only after a long history of stomach trouble. Of course in these cases the actual malignancy probably belongs to the latter part of the history, but then we have no means of guessing at this.

For clinical purposes we may group the symptoms of early cancer of the stomach in the following manner:—

Cases in which there are at first no Gastric Symptoms.

1. Latent cases, with no symptoms of any kind until shortly before the fatal event.

2. Cases marked by progressive emaciation and wasting.

3. Cases in which a gradually increasing anæmia is the most prominent sign.

4. Cases in which there are symptoms, but of some other disease altogether.

5. Patients in whom the first symptoms are due to the metastasis of the cancer to other organs.

Cases which from the first show Distinct Symptoms referred to the Digestive Organs.

6. Loss of appetite in conjunction with loss of weight the main or only symptoms for a long time.

7. Sinking sensations at the pit of the stomach.

8. Cases presenting the symptoms common in chronic gastritis and in some functional affections of the stomach—belching of wind, distension of the stomach, fulness after meals, and flatulence.

9. Cases marked by nausea and vomiting in the absence of any demonstrable pyloric obstruction.

10. Cases in which the chief complaint is of actual pain.

I shall attempt to give examples of cases of cancer of the stomach commencing in these different ways, premising that my descriptions are not to be looked upon and criticised as exhaustive reports of the cases in question, but only as giving just so much of their history as may be necessary to illustrate the different points.

Latent Cases with no Symptoms of any kind until shortly before Death.

Such a case is that reported by Friedenwald.*

A man of 70 years of age died suddenly from gastric hæmorrhage, having had previously no symptoms of any kind. After death an adenosarcoma was found which occupied both the anterior and posterior walls of the stomach.

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* *Medical Record*, September 1, 1898.

In the following case the disease must have advanced very far before any symptoms occurred.

Mr. L——, æt. 64, had been a patient of mine for some ten years, during which time he had enjoyed very good health with the exception of occasional attacks of piles, due apparently to a little too free enjoyment of the pleasures of the table. He was a hale and hearty old man who hunted several times a week, and dined out constantly at public dinners. In 1900 he consulted me for a sudden attack of gastric pain accompanied by faintness, with which he had been attacked whilst hunting. This was so severe as to compel him to desist from the sport and return home. Upon examination the stomach was obviously dilated, splashing was obtainable three fingers' breadth below the umbilicus, and visible peristaltic waves could be seen traversing the stomach. No tumour could be made out, but there was considerable tenderness over the region of the pylorus. From this point the patient rapidly failed, vomiting set in, and death ensued about eight months later. The vomit became "coffee-ground" about a month after the first discovery of the dilation of the stomach.

Cases marked by Progressive Emaciation and Wasting as the Earliest Symptom.

Mr. J. A——, æt. 67, was seen with Dr. C—— on December 1, 1899. Patient has been getting thinner and weaker for the last year. Until quite recently there has been no pain or discomfort. Has absolutely no appetite for meat Complains of gastric discomfort, but only after large meals. No nausea or vomiting. Nothing abnormal to be made out in the abdomen.

The following case is also an example of this:—

Mrs. S——, a lady of 40 years of age, was seen in consultation on October 8, 1895. Has absolutely no gastric symptoms, but has been losing flesh slightly for some little time. Has never had any pain or vomiting, fulness, flatulence, or any other symptom suggesting stomach trouble. About a week ago she noticed a swelling in her abdomen. On palpation a nodular hard tumour could be made out of the size of a tangerine orange in the region of the pylorus. It was painless, freely movable, and could be pulled right over to the left of the umbilicus.

Operative interference was declined, and the patient died of unmistakable malignant disease some months later.

Major-General S——, æt. 76, consulted me on April 4, 1902. Has been in India thirty-six years, and suffered from malaria there. Has always been subject to constipation. His health commenced to fail last July, and his weight became gradually reduced from 14 stone to 11 stone 2 lbs., which it is to-day. Discomfort in the stomach is very slight and occasional. Appetite is practically nil, and his chief complaint is of great and increasing weakness. On examination a tumour, evidently connected with the stomach, can be made out just below the right costal cartilages. The case was obviously unsuitable for operation on account of his age and debility.

General M——, æt. 60, seen with Dr. G—— on October 28, 1899. The patient has been getting thinner for some considerable time, being now 3 stones below his normal weight. Complains of loss of appetite and slight flatulence. No pain or discomfort of any kind. On examination a rounded tumour, moving up and down with respiration, can be made out in the epigastric region.

Cases in which the earliest Symptom is Anæmia.

Mrs. B——, æt. 27, consulted me on September 8, 1896. Has been married three years, and has had two children. Has suffered from dyspnœa and palpitation since fourteen years of age, but has been much worse since the birth of her last child five months ago. Complains now of feeling always tired and of fainting fits from slight causes. Appetite is fair, and she has not lost flesh. No œdema of the feet. Hæmoglobin, 35 per cent. Red corpuscles, 2,000,000. Examination of the abdomen negative. There are several septic stumps in the mouth, attended by considerable pyorrhœa.

This patient died a few months later with undoubted malignant disease of the stomach.

This case is interesting from several points of view. In the first place, it is an example of malignant disease of the stomach occurring at an unusually early age; it is noteworthy from the fact that the only morbid sign for a long time was an increasing anæmia, remarkable for the characteristic deficiency of Hb (*vide* page 18); and there is the question what effect, if any, the septic mouth had in the production of the symptoms.

Cases where Loss of Appetite in conjunction with Emaciation are the first Troubles noticed by the Patient.

From a diagnostic point of view this is probably the most important purely subjective symptom in the first stage of cancer of the stomach.

Whilst its absence will not exclude cancer, many patients preserving their appetite until a comparatively advanced stage of the disease (*vide* Osler and McCrae*), yet when present, especially in a man beyond middle age who has commenced to lose weight, we are justified, even in the absence of all dyspeptic symptoms, in strongly suspecting the presence of malignant disease of the stomach. Such a case is the following:—

Mr. J. A——, æt. 67, sent to me by Dr. C—— on December 1, 1899. Has been getting thinner and weaker for the last year. Has now no appetite for food and a positive aversion to meat, which he can only with difficulty be induced to take. The empty stomach is never painful, small meals cause no discomfort, and it is only after large meals that he experiences any uneasy sensation. There is neither nausea nor vomiting. The stomach contents after a test dinner containing meat show a considerable HCl deficit and numerous coarse particles of undigested food.

Cases marked by a Sensation of Sinking at the Pit of the Stomach.

Miss M——, æt. 33, came under observation in May, 1900. Has had stomach trouble for the last twelve years; much worse during the last eighteen months. Five years ago had an acute gastric attack which lasted nine weeks, during which time she took practically nothing except Benger's food. There was no pain nor vomiting. Her chief trouble now is a feeling of sinking and emptiness after meals. She always feels tired, and yawns a good deal. Appetite pretty good. In the early morning before breakfast she feels sick, especially when she cleans her teeth, but never actually vomits. She is markedly anæmic, and the gastric juice shows considerable HCl deficit and loss of peptic power. No tumour can be made out on palpation.

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* Osler and McCrae, "Cancer of the Stomach," p. 38.

Mrs. B——, æt. 72, consulted me on December 12, 1900. Her present trouble came on gradually two years ago, until which time she had enjoyed good health. Her own idea is that her present illness was induced by a period of great worry and anxiety through which she had passed. She now complains of a sinking feeling before meals and pain about half an hour afterwards, which she describes as a kind of scraping feeling. The pain, which appears to be somewhat of a burning character, lasts until late in the afternoon. It is unrelieved by food, and only slightly by bicarbonate of soda. No tumour can be discovered. Examination of the stomach contents shows HCl deficit with excess of lactic acid.

Cases presenting the Symptoms common to the different Forms of Chronic Indigestion.

It is into this group that the great majority of cases of cancer of the stomach fall in their early stage.

Mr. W——, æt. 50, was sent to me for an opinion in March, 1901. His present trouble commenced with flatulence usually in the afternoon, accompanied by a feeling of distension. His appetite is very poor, in consequence of which he eats very little. Is able to take liquid food, but finds a great difficulty with solids, as he cannot get himself to chew them. Has never vomited except four months ago after taking several cups of tea. On examination a tumour can be made out in the epigastrium, apparently 3 cm. broad by 8 cm. in length, movable up and down, and obviously connected with the stomach.

H. L——, æt. 37, comedian. First seen on May 4, 1895. Was quite well until the last few weeks, when he began to be troubled with indigestion. Fulness after food, especially and almost immediately following the principal meal. Has no absolute pain. Belching of wind occurs at any time in the day with apparently no time relations to meals. Appetite is bad. Slight constipation is present, there never being a satisfactory motion without medicine. Sinking feeling at the pit of the stomach.

Dr. K——, æt. 42, consulted me on April 17, 1900. Present illness commenced about the end of January, 1895, before which date he had had occasional indigestion. The symptoms at first consisted of a feeling of fulness at the end of meals, lasting about half an hour, and accompanied by frontal headaches. There is now fulness after each meal quite irrespective of the amount, sometimes after a few mouthfuls have been taken. At other times it occurs only at the end of the meal or a few minutes after. The sensation is a pressure, not actual pain. The feeling of fulness is sometimes present before a meal when the stomach is empty. When he is eating he has an inclination to fold the arms across the chest, as the pressure relieves the uneasy sensation. Slight eructation of wind takes place for about an hour after meals. When he is worse eructations do not occur, but in this case the feeling of distension is much increased and there is splashing to be made out in the gastric region on palpation. Usually feels better in the morning than at any time in the day, but often wakes up with a dull feeling in the head or slight headache. Is often quite hungry before a meal, but is very soon satisfied, and has to force himself to eat any more. Satisfaction after a meal is very rare, discomfort usually commencing at once. There is no vomiting or nausea.

Mr. G. H——, æt. 65, manufacturing chemist, consulted me on April 24, 1894. About ten years ago he began to be troubled with his stomach, experiencing slight discomforts about two hours after meals. A little later he commenced to have periodical attacks of "gastric catarrh," for which he consulted Dr. Samuel Fenwick, who put him upon a liquid diet. Three years ago he consulted another physician, who told him that he had a dilated stomach.

He now complains of intense gastric discomfort at 3 a.m., which lasts two or three hours. He occasionally gets a similar attack after lunch, but not after breakfast or dinner. Bowels are relaxed, and he passes a considerable amount of flatus.

Splashing can be obtained below the umbilicus, but no tumour can be made out. The stomach contents after a test breakfast contain no HCl and a small amount of lactic acid.

General C——, consulted me early in 1901, æt. 59, has been in India many years. Had no malaria or other serious illness in India. Nineteen years ago commenced to suffer with his stomach, the symptoms consisting of fulness and flatulence after meals, accompanied with epigastric tenderness. By adopting a very restricted diet he managed to get along pretty comfortably until a year ago, when he commenced to lose flesh. He now suffers from almost constant discomfort, especially after lunch. On examination no tumour can be discovered, but there are coarse food residues after a Riegel's test meal with HCl deficit and presence of lactic acid.

Mrs. C——, æt. 40, consulted me on July 6, 1901. She has had indigestion for two years, and has lost one stone during the last few months. Complains now of fulness after meals and loss of appetite. On examination a movable circumscribed lump can be made out to the right of the midline just above the umbilicus. An exploratory operation was advised, but declined by the patient.

The patient left me and placed herself under the care of an unqualified medical electrician, who promised her a cure, and, as far as I can learn, treated her by local percutaneous application of the current from a small induction-coil apparatus. Six months later the patient again consulted me and wished to undergo an operation, but it was then too late, as the entire abdomen appeared to be filled with a nodulated mass.

Cases marked by Nausea and Vomiting in the absence of Pyloric Obstruction.

Mrs. D——, æt. about 40, was seen in consultation with Dr. B—— on January 2, 1894. The patient had been suffering from cancer of the uterus for some few months. For the last few days has been vomiting, and now cannot keep anything upon her stomach except a little milk and lime-water. An examination of the vomit gives no reaction to Congo red, but shows a considerable amount of lactic acid.

Mr. W——, æt. 80, was sent to me in March, 1900, for an opinion. Has enjoyed good health until the age of 70, when he had an attack of epidemic influenza. Had another attack two years ago, since which he has been declining in health. Since his last illness has been troubled with almost constant hiccough. Appetite bad, especially for solid food. Complains of a persistent bitter taste in the mouth. On examination no tumour can be made out in the abdomen. After an Ewald test breakfast the stomach contents shows entire absence of HCl and considerable quantities of lactic acid. The case eventually turned out to be malignant disease of the greater curvature.

Cases where Pain is a Prominent Symptom.

In some cases the pain may be more or less constant, as in the following, which also illustrates the fact that in some few cases absolutely the first symptom is waterbrash.

Mr. C——, æt. 38, has suffered for many years with indigestion. Two years ago he commenced to be troubled with waterbrash and to lose weight. Has had since the commencement of his illness an epigastric pain which is dull, continuous, and not severe except when occasionally increased by an extra large meal. A year ago he commenced to vomit several times a day, and entered one of the large metropolitan hospitals where his stomach was washed out a few times and he was discharged. He has now a distinct tumour in the region of the pylorus and a stomach which is evidently much dilated. Upon operation a malignant mass was found, involving the pylorus, which, however, could not be removed on account of adhesions and extensive involvement of the neighbouring parts.

Gastro-enterostomy was performed, and the patient lived some months in comparative comfort.

In other patients the pain at first coming on at the height of the digestive period may simulate hyperchlorhydria, later in the course of the disease becoming more continuous. The following interesting case, reported by Macleod in the *Lancet* of December 24, 1892, is an example of this.

"Miss C——, aged 50 years, consulted me for the first time on April 4, 1890, for indigestion. She stated that she had always enjoyed good health till towards the end of 1889, when she had a sharp attack of influenza, from which she made a very slow recovery, and then, for the first time, symptoms of indigestion set in. The patient was a thin, wiry, pale-complexioned person. She complained of pain over the region of the stomach about an hour after taking food, which passed off in about half an hour, leaving her entirely free from pain till the next meal. Tongue very much furred; bowels constipated; appetite poor; stomach and bowels distended with flatulence. Nothing abnormal could be detected on examining the stomach. She had had no vomiting, but complained of acidity. I put her on a course of bismuth, rhubarb and soda, and carefully dieted her. On this treatment she seemed to improve, and left Dundee on May 6th for a change of air. On June 18th she again reported herself; she appeared to have improved by the change, but still suffered more or less from a fixed pain in the stomach; referred to a spot towards the left of the epigastric region. After seeing her for a few days she went to the Highlands for a further change, where she remained for about six weeks. Towards the middle of September, however, the pain appeared to increase, and was more constant than before, and now was not influenced by food; the pain was of a dull aching character, referred to a spot in the left epigastric region. She also complained very much of flatulence, with fetid eructations. Various remedies were tried, peptonised foods prescribed, but the pain persisted. Bismuth and morphia in powder were ordered, which had a decided effect in dulling the pain. About the middle of December, Professor Grainger Stewart of Edinburgh saw her in consultation, and after a careful examination could detect no organic lesion, although by this time she had emaciated very much and had a cachectic appearance. He gave as his opinion that the dyspepsia was of a neurotic nature, and advised very much the same treatment to be continued. For a few weeks she appeared to rally and kept comparatively free of pain while taking the bismuth and morphia. Her appetite was wonderfully good and the food well digested, but she steadily emaciated from week to week and died on May 19th without any pain or suffering during the last fortnight of her life, and was calm and collected to the end.

"On May 20th Dr. Stalker, for some time pathologist to the Dundee Royal Infirmary and my junior colleague there, kindly conducted the post-mortem examination along with me, and we found as follows: The body was extremely emaciated and anæmic, with commencing œdema of the extremities. On opening the abdomen the stomach was found adherent to the under surface of the left lobe of the liver, and was held well back. The adhesion took place all along the line of the lesser curvature of the stomach, from the pylorus to the cardiac end. The pylorus itself was surrounded by a thick hard band or ring of scirrhous cancer, interrupted only at the posterior part, where for about half an inch the ring was almost absent. A finger could very easily be passed through the pylorus. There was no dilatation of the stomach and no secondary deposit anywhere."

That in some cases the symptoms may really be due to hyperchlorhydria is demonstrated by the following case, reported by Dr. Gwyn in the *Philadelphia Medical Journal*, May 16, 1903 :—

"C. M——, 45 years old, male, bookkeeper, an excessively active nervous man, was seen during March, 1902, complaining of distress in the stomach two or three hours after eating, flatulence, belching, and constipation. The trouble had already existed in a marked degree for four months, and he had been for six weeks in a sanatorium, where rest, milk, and soft diet had but temporarily improved his condition. He was slowly losing weight and strength ; his appetite, however, had remained fair, but any proteid food seemed to cause intense irritation, and comfort could only be obtained by the simplest foods. No mass was to be felt in the epigastrium, but extreme dilation and gastroptosis were readily made out through the thin abdominal walls by the aid of the stomach tube. The gastric contents, one and a half hours after an Ewald test breakfast, showed no great retention as judged by the amount, but the total acidity was 70 and the free HCl 55. There was no lactic acid and no bacilli. This condition persisted, and four months later a tumour developed, apparently about 8 by 5 cm., which could be readily grasped. From this date the patient steadily declined. A constant pain in the region of the lower thoracic vertebræ and at the costal margin developed, and at the same time the mass seemed more deeply seated and less readily felt. An increasing gastric distension helped to obscure the field. During the autumn small subcutaneous nodules developed in the skin of the abdomen below the xiphoid cartilage. The blood condition then was Hb 40 per cent., red corpuscles 2,617,000, white corpuscles 6,000, comparing very favourably with that after the patient was first seen—Hb 50 per cent., red corpuscles 2,468,000, white corpuscles 4,000; nor did he lose flesh as rapidly as we might expect from the constant pain, lack of nourishment, and probable gastric tumour. There was distinct indicanuria. . . . In addition to these more or less ordinary symptoms of gastric neoplasm the patient showed an unusual condition of intense stupor on four occasions within the last six months. A post-mortem examination showed the tumour to be an adenosarcoma."

The Examination of the Blood.

The changes in the blood in cancer of the stomach, although not able alone to lead us to a diagnosis, are sufficiently definite to render us considerable aid.

The Red Corpuscles.—In the very earliest stage of the disease there is very little change, but as a rule by the time the patient applies for treatment there is a distinct anæmia. A marked peculiarity of cancer of the stomach is that the percentage of hæmoglobin is lower than we should expect it to be judging from the number of red corpuscles. The reason of this lies in the fact that these corpuscles are usually diminished in size and we find numbers of microcyte. Large forms such as are met with in pernicious anæmia are hardly ever present, but nucleated corpuscles are the rule in advanced cases, and occasionally are met with quite early in the course of the disease. According to Cabot * cases of cancer of the stomach "differ in this respect from tuberculosis, and most other conditions involving secondary anæmia, in that the nucleated red cells may appear even when there is no considerable loss of red cells, or even when the Hb is normal."

These nucleated cells are in ordinary cases normoblasts. The diminution of red cells and hæmoglobin is usually progressive from the commencement of the disease, the red corpuscle count eventually sinking to between two and three millions per cubic millimeter.

Leucocytes.—Before discussing the changes which may take place in cancer of the stomach it will be as well to briefly discuss the process of leucocytosis, and the easiest and most practical method of counting the white corpuscles in the blood.

In my opinion the best and simplest apparatus for counting the white corpuscles of the blood is that of Thoma-Zeiss, used with a diluting fluid consisting of one third of one per cent. solution of glacial acetic acid. This destroys the red corpuscles and renders the white ones visible. As this apparatus is familiar to us all, I will only devote a short space to describing a modification of using it suggested by Dr. Franklin White, of Boston, which considerably shortens the time occupied in the count. The counting chamber of the Thoma-Zeiss apparatus has at its centre a ruled space of one millimetre in area divided into four hundred squares. In making the count of the leucocytes one is directed to examine two drops of the diluted blood in succession, and count the number which is found in the whole of this area each time. The equivalent of this may be done at one operation if you have your eye-piece fitted with a square diaphragm of such a size that, using a No. 1 eyepiece and a No. 5 Leitz objective, the field disclosed will contain exactly one hundred squares, or one quarter of the ruled-off area. It necessarily follows that if you count the number of corpuscles in eight of these square fields taken in succession across the counting chamber, you will have accomplished exactly the same thing as if you had taken two drops and counted the corpuscles in the ruled area twice. And as you are not depending upon the lines ruled on the counting chamber, but count the whole number of corpuscles appearing in the square field, you are enabled to utilise the part of the counting chamber lying outside the ruled squares —a great advantage, as the lines are always difficult to see. Baker, of Holborn, who made my diaphragm for me, is prepared to fit one to any microscope which may be sent him, at a very small cost.

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* Cabot, "Clinical Examination of the Blood," p. 292.

Before we can learn anything useful to us from the numeration of the white corpuscles, we must have a distinct idea of their number in health, and under what conditions variations may occur. I shall therefore commence by giving a very brief *résumé* of what we actually know with reference to these matters.

Normal number of white corpuscles.—In a healthy adult there are approximately 7,500 per cubic millimetre—sometimes more, and sometimes less. The amount in any particular individual will vary with the general level at which nutrition is maintained. The better nourished a man is, the higher will be his leucocyte count. Thus 5,000 and 9,000 white corpuscles per cubic millimetre might be quite consistent with perfect health in two persons respectively—the former of poor physique, taking a minimum amount of food and insufficient exercise, whilst the latter was a beef-fed athlete.

Although it is now generally recognised that the leucocytes in the blood are of at least four kinds, yet for practical purposes we need only take into consideration two of them—the lymphocytes and the polymorphonuclear white corpuscles. The former, which are now looked upon as the younger corpuscles, form about 25 per cent. of the white corpuscles; whilst the latter, the older or adult corpuscles, practically form the remainder. The lymphocytes are chiefly of clinical value in chlorosis, leucæmia, and some of the diseases peculiar to children, but the polymorphonuclear leucocytes can give us a great deal of information as to the nutrition of the individual.

But what I wish chiefly to point out to you is the value of the information which we may derive by simply counting the number of leucocytes without reference to their kind—in the first instance at any rate,—since if we eliminate the diseases mentioned, any increase in the number of leucocytes will almost always be either in all the varieties in proportion, or in the polymorphonuclear ones alone.

Increase in the number of these corpuscles is termed *leucocytosis*, and does not necessarily mean an absolute increase in their number in the blood, but that there is a relative increase in the number present in the peripheral capillaries.

We may divide leucocytosis into two groups, *digestion* or *normal leucocytosis*, and *permanent or pathological leucocytosis*.

In a healthy human being, an ordinary mixed meal is followed in from two to three hours by an increase of about 3,000 per cubic millimeter on his normal count. This is called *digestion leucocytosis*, and depends upon the absorption of the products of digestion from the stomach and intestines. In estimating its presence or absence we must always bear in mind the normal count of the individual, if the total number counted does not exceed 13,000. For whilst in a badly-nourished patient whose leucocytes averaged 5,000, 8,000 would show that digestion leucocytosis was normal, the same number in a man whose normal count was 10,000 would mean that the leucocytes were absolutely in defect. But since we hardly ever meet with a normal count above 10,000, we may take all figures above this + 3000 as indicating leucocytosis, without troubling to obtain the normal count.

In digestion leucocytosis the lymphocytes and the polymorphonuclear corpuscles are increased in proportion. In most of the pathological leucocytoses which we shall study, the increase is chiefly in the polymorphonuclear corpuscles.

We may learn a great deal from the digestion leucocytosis.

1. It may be absent. It is usually absent in cancer of the stomach. It is generally present in ulcer. When we find an absence of the normal digestion leucocytosis, we know that there is some condition present which materially interferes with the absorption of food products from the alimentary canal.

2. It may be late, and instead of coming on a couple of hours after a meal, it may be four or five. This tells us that the digestive processes are unduly retarded. We meet with such a condition in atonically dilated stomachs, which do not empty themselves into the duodenum until long after they should do.

When leucocytosis occurs at other times besides the digestive period—that is to say, when the blood constantly contains more than its normal count of leucocytes, we call it *pathological leucocytosis.* In order to eliminate the possible error of digestion leucocytosis, we should always take the blood count either just before or after a meal, or before breakfast. We must also not forget that if the digestive processes are normal in an individual who has permanent increase in the white corpuscles, the ordinary digestion leucocytosis will be added on to this after meals in the usual way. As a rule we do not trouble to use the term *pathological* when we talk about leucocytosis. This is always meant unless we specify *digestion leucocytosis.*

The main conditions under which leucocytosis may occur are hæmorrhage, inflammation, certain poisons and malignant disease. We shall take these in order.

Hæmorrhage.—A hæmorrhage of any extent is followed within an hour or two by a considerable leucocytosis. This persists for from one to three days and then passes off.

Inflammation.—We know that all inflammation is the local expression of the struggle of the organism with some septic material introduced or in contact with some of its tissues. The leucocytosis produced appears to vary with the resisting power of the organism. If the poison is slight and the resisting power good, the resulting leucocytosis will be slight. If the dose is more serious it will be greater. If the dose of the poison is so great that the organism is unable to struggle against it, leucocytosis will be absent. So we see that a slight leucocytosis may mean either that the affection is a mild one or that it is mortal. Leucocytosis is practically present in all inflammatory conditions—slight when it is localised, and severe when it is diffused.

Toxic leucocytosis.—It has been experimentally proved—

1. That leucocytosis follows the injection of certain organic extracts, peptone and nuclein. For instance, the daily count of a patient on whom I am injecting daily 2 cc. of a 1 per cent. nucleinic acid solution is 24,000.

2. It is present practically in all the acute infectious fevers except typhoid, influenza, rötheln, and is absent in malaria and all forms of tubercle.

3. It is present in certain affections probably due to some toxic agent, such as gout, acute yellow atrophy of the liver.

4. It is present in gastro-intestinal affections in which we may presume there is some absorption of toxines from the alimentary canal.

Let us now see if we can apply these facts to the diagnosis of the diseases of the stomach.

Diseases of the stomach.—The affections of the stomach which we meet with most frequently in daily practice are ulcer, carcinoma, acute gastritis, chronic gastritis, and the functional derangements of motor power, secretion, and sensibility, the commonest of these being atony and dilatation of the stomach, hyperchlorhydria, and gastralgia. Out of this list, leucocytosis is present in acute gastritis, slightly in hyperchlorhydria, and in about one third of cases of cancer of the stomach, but more frequently when metastasis has occurred to other organs.

We are therefore justified in drawing the following practical deductions:—

1. In both ulcer of the stomach and hyperchlorhydria there may be acute pain coming on after food. In the former affection there is practically never any leucocytosis unless there has recently been a hæmorrhage; in hyperchlorhydria, on the other hand, there is usually a certain degree. If, then, in a case presenting the symptoms which suggest ulcer of the stomach we find a marked leucocytosis, we may conclude that there is some other affection, possibly hyperchlorhydria, present.

2. As regards the differentiation between a malignant and non-malignant ulcer, the finding of leucocytosis would suggest the former. If in addition there was an absence of digestion leucocytosis, our suspicion would be confirmed.

3. It often happens in practice that the problem before us is whether a patient is suffering from advanced chronic gastritis with atrophy of the

secreting tissues of the stomach, or from some malignant affection. In the former we shall probably find a deficiency of white corpuscles (leucopenia), and that the digestion leucocytosis is delayed; in cancer that there is a distinct leucocytosis, and that the digestion leucocytosis is absent.

4. In simple atonic dilatation of the stomach, leucocytosis is usually absent and digestion leucocytosis delayed.

If we find the physical signs of a dilated stomach associated with marked leucocytosis, we are justified in strongly suspecting malignant stricture of the pylorus.

Taking everything into consideration, at first sight it would appear that as a sign of cancer of the stomach digestion leucocytosis is of little practical value, as in ulcer of the stomach it is absent in about the same percentage of cases. Hoffman,* indeed, found it absent in 21 out of 24 cases of cancer of the stomach and in 6 out of 9 cases of ulcer. But we must bear in mind that in the first place the problem met with in practice is usually not the differential diagnosis between these two affections, and secondly that ulcer in the majority of cases will present some well-marked features by which a distinction may be made. Recently Osler and McCrae † think that its importance is questionable, as in 22 cases of cancer it was only absent in 12, and in children it is often present. The answer to this is that in children we do not expect to find cancer of the stomach, and in adults, although the presence of digestion leucocytoses may not exclude cancer, yet its absence will be a strong argument.

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* "Zeit. f. klin. Med.," band xxxiii., p. 460.

† *Op. cit.*, p. 118.

We must remember that in cancer of the stomach we have two sets of factors always in operation—one, such as hæmorrhages, metastases, and inflammatory complications, always tending to produce leucocytosis; and the other set, loss of nutriment, toxines circulating in the blood and probably degenerative changes in the blood-producing organs, tending to diminish the number of leucocytes. And according as the one or the other preponderate do we get an increase or diminution in the leucocytes in the blood. According to Van Valsah * there are always degenerative changes in the white corpuscles themselves, "the nucleus of the lymphocytes becomes poorer and poorer in chromatin as the cytoplasm diappears, loses its form and structure, enlarges and finally undergoes dissolution. The polynuclear leucocytes are affected by hyperchromatosic degeneration. As many as ten per cent. of the leucocytes may be degenerated, and these degenerate corpuscles go to pieces in the circulation, appearing as formless protoplasmic masses in the fresh and the stained preparations of the blood."

Differential Diagnosis between Cancer of the Stomach and Pernicious Anæmia by means of the Blood.

There are three points which will help us :—

1. In pernicious anæmia the blood count falls lower than in cancer of the stomach, the number of red corpuscles in the latter affection rarely falling below two million per cubic milimeter. When we

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* Van Valsah and Nisbet, "Diseases of the Stomach," p. 538.

find it less than this we may usually exclude the gastric disease.

2. In malignant disease the cachexia is relatively more advanced than the decline in the blood, whilst in pernicious anæmia the reverse obtains. Both these interesting and valuable facts were pointed out by Henry * in a paper in the *Archiv. f. Verdauungskrankheiten*, which is of such extreme interest that I feel sure that my readers will pardon me if I briefly abstract the whole article.

BRIEF ABSTRACT OF DR. HENRY'S PAPER.

It is well known to all clinicians that cancer of the stomach can remain latent for long periods, the symptoms present being referred to other organs. Many, in fact most, cases of cancer of the stomach show a remarkable likeness to pernicious anæmia. Consequently the diagnosis usually rests between these two affections, and in consequence, if you can exclude the one the chances are strongly in favour of the other being present. As a result of this I have frequently been able to establish the presence or absence of cancer by the following method, which I have used with success for many years. This method is nothing more than a counting of the red corpuscles. Never have I seen a case of cancer of the stomach in which the count of the reds fell below 1,500,000 per cubic millimeter, and in one of my cases I counted 2,760,000 the day before death. *Per contra,* I have never seen a fatal case of pernicious anæmia in which the red corpuscles did not fall below 100,000. I think, therefore, that we are justified in formulating the following rule:—

"Die Verminderung in der Zahl der roten Blutkörperchen bei Carcinom des Magens halt nicht Schritt mit der Cachexie, bei peroiciöser Anamie hält die Cachexie nicht Schritt mit der Oligocythämie."

I feel that I cannot lay too much stress upon the importance of the numeration of the blood corpuscles in obscure cases of stomach trouble, as by means of this we can in many cases not only diagnose cancer but exclude other diseases besides pernicious anæmia. In 1890 a patient was sent to me by Professor Keen with an obscure stomach affection. The patient was much emaciated, cachectic with a straw-coloured skin. His chief trouble was pain after food. The diagnosis rested between cancer of the stomach, pernicious anæmia, and a chronic gastric neurosis. The red corpuscles were found to be 3,950,000 per cubic millimeter and the HB 70 per cent. These counts, in conjunction with the duration of the affection, which exceeded one year, excluded cancer of the stomach and pernicious anæmia. This diagnosis was justified by the fact that the patient recovered under appropriate treatment. The point which I wish to insist upon is that in cancer of the stomach the count of red corpuscles is as a rule between 2,000,000 and 3,000,000 per cubic millimeter, and continues so during life, whilst in pernicious anæmia it is much lower, falling sometimes before death to 500,000.

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* Henry, "Ueber den diagnostichen Wert der Blutkörperchen Zählung beim latenten Krebs." *Archiv. f. Verdauungs.*, band iv., p. 1.

3. According to Sailer and Taylor,* during the cachexia of carcinoma we find a relative increase in the number of large, mononuclear leucocytes, whilst in pernicious anæmia it is the lymphocytes which are in excess.

The Gastric Juice.

In about 10 per cent. of cases of cancer of the stomach, the gastric juice remains practically normal in respect to acid and ferments until near the end of the case. In about 20 per cent. hypochylia developes slowly and does not reach its maximum until late in the disease, but in the remaining cases, over 60 per cent., hypochylia begins early and developes rapidly (Van Valsah). The diminution in the HCl secreted depends partly upon destruction of glandular tissue by the invasion of the cancerous cells, partly upon

onal Medical Magazine, 1897, p. 405.

inhibition of the glandular work of the stomach by toxins secreted by the cancer, but is mainly due, as Riegel has pointed out,* to the presence of an associated chronic gastritis.

The cases in which the gastric secretion remains normal will either be those in which we have an old ulcer becoming cancerous, or cancer affecting the cardia. In most cases first of all the free HCl commences to diminish day by day until it finally disappears. The diminution in the secretion still going on, the next to suffer will be the combined HCl, which will show a daily increasing deficit. The pepsin and rennin will diminish *pari passu* with the HCl, and the gastric juice will day by day present less power of digesting proteids. It will, therefore, be evident that for diagnostic purposes little can be learned by one single examination of the gastric juice. If in such a case we found a diminution of the HCl or ferments it might mean nothing, being either due to an ordinary chronic gastritis or to a temporary dynamic condition. The important point to bear in mind is that to establish the probability of malignant disease, we must find a *progressive deterioration* of the gastric juice, and this can only be established by a series of examinations extended over a considerable period of time. We may also learn that it is not sufficient to make out the mere fact that HCl is absent in the free state, we must measure the actual HCl deficit. This, by the way, is not at all difficult, and is performed in the following manner :—

We take 10 cc. of the unfiltered stomach contents, add a decinormal solution of HCl until the addition of dimethyl-amido-azo-benzol or congo red shows the presence of free HCl. The quantity of decinormal solution of HCl used, multiplied by 10, will represent the HCl deficit per cent.

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* "Diseases of the Stomach." Nothnagel's "Encyclopedia of Practical Medicine," p. 677.

The digestive power of the gastric juice is most conveniently estimated by the method of Hammerschlag. First of all a solution is made containing 1 per cent. of acid albumin. The best way of doing this is to make a 0·4 per cent. solution of HCl, and dissolve one gramme of commercial albumin in each 100 cc. Let it stand twenty-four hours and filter.

We now take two beakers, into each place 10 cc. of the acid albumin solution; to the first we add 5 cc. of the gastric contents, and to the second 5 cc. of distilled water. The next step is to take two Esbach tubes, (*a*) and (*b*), and fill them with the respective mixtures up to the mark U, place them in a water bath at 37° Centigrade for one hour, remove them and fill up to the mark R with Esbach's solution. They are now put away to stand twenty-four hours, at the expiration of which time the amount of precipitate is read off. The tube (*b*) will be used as a control, and as no digestion has taken place in it the amount of sediment will be a measure of the amount of albumin. The difference between the amount of sediment in the tube (*a*) and that in the tube (*b*) will be the amount of albumin which has been digested by the gastric juice. If for example tube (*b*) contains 10 per cent. of albumin, and tube (*a*) 5 per cent., we may say roughly that the digestive power of that particular sample of gastric juice is 50 per cent.

The processes which I have described I am afraid appear rather complicated, but fortunately they are by no means absolutely necessary in actual practice, as a macroscopic examination of the stomach contents will usually tell us all we want to know. In other words, a simple inspection of a test meal containing meat and bread extracted from the stomach some four hours after ingestion, will probably give us all the information we want. If we find coarse bits of undigested meat the peptic power of the gastric juice must be practically much reduced. If we find that the bread is in finely divided particles, and that the meat has practically disappeared, then the gastric juice is probably normal and there will be no HCl deficit. In my own opinion methyl violet is the best simple test for the quality of the gastric juice. If it is turned blue, then the secretion of the stomach is sufficiently normal for practical purposes. The exact method of performing the test will be found in my recently published work.* As regards the diagnostic significance of a HCl deficit, I cannot do better than quote some very apposite remarks of Riegel.† "In heart disease ausculatition is valuable but not sufficient to make a diagnosis, and in stomach disease a determination of the HCl alone is not sufficient. Only in combination with the subjective symptoms of the patient, the determination of the size and position of the stomach, its motor and absorbing powers, is the determination of HCl of value."

As regards the finding of coarse food particles in the stomach, a common source of fallacy is found in the fact that in the early stages of cancer the motility of the stomach frequently remains normal. In this case, the food, although not digested, having been expelled through the pylorus, we may find the stomach empty when we proceed to extract its contents, and erroneously come to the conclusion that the digestive power is normal. It is therefore a good rule, whenever we find the stomach empty four hours after the test dinner, to repeat the test meal and to extract again an hour earlier. Another point to bear in mind in investigating these cases, is that the Ewald test breakfast is not sufficient, as we require a test meal which contains meat.

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* Herschell, "Manual of Intragastric Technique," 1903.

† Riegel, *op. cit.*, p. 23.

LACTIC ACID IN THE STOMACH.

It was formerly held that the first stage of digestion in the stomach was marked by a secretion of lactic acid.

We now know that this is erroneous, and that if no lactic acid or bacilli capable of producing lactic acid fermentation are taken with the food, no lactic acid will be produced during the digestive period—that is to say, if such germs are absent from the stomach.

Wherever we find stagnation of food in the stomach, in association with deficiency of HCl, there we shall find lactic acid and the microorganisms which produce it.

It was Turck of Chicago who first demonstrated the extraordinary fact that in certain cases it was possible to wash out a stomach by means of ordinary lavage, until the wash-water came away perfectly clean and neutral, and then by means of the gyromele, an instrument of his own invention which consists essentially of a small sponge upon the end of a revolving wire cable, to remove from the walls of the stomach masses of mucus containing large colonies of bacteria.

He also established the fact that in the majority of cases of cancer of the stomach in the earliest stage, almost pure cultivations of bacilli could be obtained in this manner from the stomach walls.

The explanation of this will be apparent if we will consider for a moment what is happening in a stomach affected with commencing malignant disease. The first stage will be the infiltration of a small portion of the wall of the stomach with the immediate effect of a local loss of motility. This will increase *pari passu* with the extension of the affected area. At last a stage will be reached when the movements of that part of the stomach wall are not sufficient to dislodge the mucus with which it is covered. Opportunities will be thus given to micro-organisms to form colonies in it, of which they will take prompt advantage, and this will be greatly favoured by the gradually increasing hypochylia. We may now wash out the stomach as much as we are able with the ordinary funnel apparatus without dislodging them, and it will require a certain amount of friction with a sponge or equivalent apparatus to do so.

We may then take it as an established fact that the removal with the gyromele of colonies of bacilli from the walls of the stomach offers us a certain proof that a portion of the stomach has lost its motility from some cause or another, and is strong presumptive evidence that there is malignant disease.

Third stage.—The HCl has now disappeared and there is a considerable degree of retention of food residues. The fermentation will be mainly due to the lactic acid bacillus, and the bacillus geniculatus will now make its appearance. When cancer first affects the body of the stomach matters are rather different.

A remarkable point in connection with cases of localised non-obstructive cancer is the fact that the fermentation in a tube is greater than one would expect judging from the quantity of food residue. As a rule we find that when there is a large residue in the stomach there will be a considerable fermentation in the tube. In most cases this is certainly the case, as the larger the residue, the greater the degree of stagnation of food. But in cases where the loss of motility is localised, other conditions obtain. In consequence of the large number of micro-organisms breeding upon the immobile patch of mucosa, we may get a small residue which will actively ferment in the tube.

The Bacilli which produce Lactic Acid in the Stomach.

Although many varieties apparently have this power, the only ones with which we need concern ourselves are the well-known bacillus acidi lactici and the bacillus geniculatus.

The bacillus acidi lactici, a pure cultivation of which is shown in the frontispiece, is too well known to require any description here.

The bacillus geniculatus is really one of the most important formers of lactic acid, and is easily recognised on account of its large size. A great deal of work has been done in connection with this bacillus by Kaufman, who established the fact that it had the power of generating lactic acid from sugar. This author asserts that its presence is generally coincident with that of lactic acid in the stomach contents; that it is perfectly safe to assume that pathological quantities of lactic acid are absent if it cannot be found; and as a microscopical examination is far easier than any of the chemical tests for lactic acid, he suggests that we should use this in preference.

THE EXAMINATION OF PORTIONS OF GASTRIC MUCOSA.

One of the greatest advances in the diagnosis of obscure functional diseases of the stomach was made when Einhorn and Hemmeter suggested the examination of fragments of mucous membrane from the interior of the stomach. Such little bits of mucosa are often found in the wash-water after lavage when an ordinary English stomach tube has been used. For many years physicians whose field of work has been the treatment of affections of the stomach have been advocating and using stomach tubes possessing eyes with rounded and bevelled edges. With such tubes it is practically impossible to produce an abrasion of the mucous membrane of the stomach. In England, sad to say, the ordinary tube supplied by the majority of instrument makers is still provided with eyes having sharp cutting edges, which, although they render it a bad stomach tube, make it an admirable curette for obtaining small fragments of mucous membrane. Hemmeter has elaborated the technique, which is perfectly simple and quite har

Although something may be learned from an examination of fragments of mucosa found in the wash-water after ordinary lavage of the stomach, Hemmeter points out that they are of very little use for the study of pathological mitosis from the fact that they will probably not be in a good enough state of preservation. It is therefore advisable to obtain what we require for this purpose by his method of curettage of the stomach. From the extensive experiments which he has carried out he has established the fact that when a tube is introduced into the stomach it will strike the lower border at about the middle and will then glide towards the pylorus. It will obviously in consequence be only possible to procure fragments from the middle and pyloric zones of the stomach, and we shall expect to be able to recognise from which of these zones they come, since the cell tubules from the pyloric zone have no border or acid cells, and have the characteristic appearance met with in this region. The tubules from the middle zone will contain both central and border cells.

Hemmeter's Curettage of the Stomach.

The process of curettage of the stomach is very simple.* The patient after having had his stomach washed out thoroughly should go to bed and be fed entirely by the rectum for forty-eight hours. The stomach is now to be washed out with normal salt solution, moving the tube gently backwards and forwards several times for a couple of inches or so. The wash-water can now be placed to settle in conical glasses, or, better still, centrifuged The sediment can now be submitted to a micro scopical examination with some prospect of su cess. It is not at all unlikely that the reason wh tissue fragments, either of cancer itself or of gastri mucosa, are not more frequently obtained in cases of suspected malignant disease is because they are not looked for in this systematic way.

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* Hemmeter, "Diseases of the Stomach," p. 561.

Before studying the several points which we may learn from a microscopical examination of fragments of gastric mucosa, we may with advantage pass in review the essential histological characters of cancer of the stomach, and also refresh our memory of the process of indirect division of cells termed kariokinesis.

In a normal stomach the mouths of the gastric glands will be about 74 microms in diameter. When abnormally small they will measure 38 microms and under, and when abnormally large 160 and upwards. In most cases in the sections the lumens will be filled with cells, but in some cases they will be empty from the cells having dropped out.

In cancer we shall find the following modifications:—

1. Atrophy of the gland tubules. 2. Fission of glands. 3. Atypical mitoses. 4. Encroachment of epithelial cells upon the gland. 5. Atypical shape of glands. 6. Epithelial proliferation between the glands.

In order to understand the reason for these changes we must have a clear idea of the cancerous process.

The essential feature of cancer is the presence of epithelial cells in abnormal situations. The stroma of the cancer is provided by the connective tissue into which the epithelial cells burrow. The character of the tumour depends upon the character and amount of the connective tissue, and the rate at which the epithelial cells proliferate. If the organ is dense and fibrous, there will be plenty of material from which stroma can be formed, and the tumour will be firm, at any rate for some time. Again, if the proliferation of the epithelium goes on only slowly, there will be time for the production of new connective tissue as the result of the stimulation by the cancer cells, which act in the same way as an aseptic foreign body. If, on the other hand, the cancer cells are of the kind which proliferate rapidly, there will be no new formation of connective tissue, but that already existing will be rapidly broken down, and the resulting tumour will be soft and rapidly growing.

In the ordinary cylindrical-celled carcinoma of the stomach the process commences by irregular and abnormal vegetation of the columnar epithelial cells. These, in epithelial masses of many layers, drive themselves down through the stratum proprium and the muscularis mucosæ into the underlying connective tissue, where they continue to reproduce themselves by indirect cell division, infiltrating it in nest-like groups. The result is a structure which is an imperfect imitation of the gland ducts and mucous glands of the gastro-intestinal canal. The cancer cells which are derived from the hypoblast are columnar in form, and attached in single or more layers to the interior of imperfect tubes. Colloid degeneration often occurs in the parenchyma and stroma of these cancers of the alimentary canal, and hence quite wrongly termed colloid cancer, just as if that were a distinct variety. Since the oldest cells degenerate first, the layer of cells next the lumen will naturally be first destroyed, and the resulting material will accumulate in it.

The essential feature of a cancerous process is the presence of cells derived from one layer of the ovum in a state of proliferation in a tissue derived from another. In cancer of the stomach we find epithelial cells derived from the hypoblast in a state of active proliferation in the vascular connective tissue derived from the mesoblast.

The cancerous process in the stomach then is characterised by "atypical proliferation of epithelium starting from the glandular cells, and the epithelium of the efferent ducts of the glands" (Riegel).*

Hammerschlag † had opportunities of examining pieces of mucous membrane removed from cases of cancer of the stomach by operation during life, and comes to the following conclusions :—

1. In cases where the secretion of HCl was normal there were no histological changes in the mucosa.

2. In cases where the HCl was deficient—

(*a*) The superficial epithelium as a rule was normal.

(*b*) The peptic glands as such had mostly disappeared, their place having been taken by tubes lined with cylindrical epithelium, which roughly imitated the appearance of the gland tubules.

(*c*) In the gland tubules which remained in the affected area the number of parietal cells was much diminished.

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* Riegel, *op. cit.*, p. 652.

† Hammerschlag, *Archiv. f. Verdauung.*, band 2.

(*d*) There was a small cell infiltration between the gland tubules showing the existence of a gastritic process.

(*e*) Among these cells were some which exhibited eosinophile properties.

As Riegel justly points out,* there is thus in cancer of the stomach a focalised destruction of rennet glands with, in addition, a secondary atrophic gastritis, as shown by the small cell infiltration and neoplastic formation of connective tissue in the gastric mucosa.

Kariokinesis is the name given to indirect division of cells. The peculiarity of this mode of division is that the nucleus of the cells as well as the nuclear membrane seems to disappear. The place of the nucleus is taken by a characteristic figure of threads which goes through an invariable series of changes of form and arrangement, dividing into two portions, which withdraw respectively to the two ends of the cell, and eventually form daughter nuclei. The nucleus of a cell contains a network of fine threads which appears to be arranged with no definite regularity, but in some places have collected to form knot-like masses. In addition to these there are usually one or two rounded nucleoli. The illustration gives a diagrammatic representation of the process of kariokinesis. At 1 we have the resting nucleus. The division of the cell has not yet commenced. When the nucleus is about to divide, the first change is that the threads become thicker and shorter, and arrange themselves longitudinally around the nucleus in such a manner that they form loops, the apices of which are grouped around one pole, the free ends extending to the opposite end of the cell. The net knots and nucleoli have disappeared, being apparently absorbed into the threads. This phase is termed the spirem, and is shown at 2. I may mention here that the substance of which the threads is composed will stain very readily with analine dies in contradistinction to the rest of the nucleus, which takes the stain badly or not at all. For this reason it is termed chromatin, and the loops formed by the thread are called chromasomes. The substance of which the remainder of the cell nucleus is composed is termed achromatin. The next step is the splitting of the loops longitudinally, although they do not yet divide, and the appearance near one pole of a body composed of fine threads called the achromatic spindle. This spindle sinks down into the body of the nucleus, finally occupying its long axis. This spindle appears to exercise a regulating influence upon the chromasomes, which follow it and arrange themselves around its equator with their loops towards it and their free ends towards the circumference of the nucleus. The figure formed is termed the monaster from its resemblance to a sunflower, and is shown at 3 in the illustration. This stage is quickly over, and is followed by the next, termed metakinesis by Fleming. The chromasomes, which had split longitudinally at the end of the spirem stage, now separate each into two halves, with the result that the mass of chromasomes divides into two groups, each of which commences to move along the achromatic spindle in opposite directions towards the respective poles. This stage is shown at 4. Having advanced nearly to the ends of the spindle they become stationary and

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* Riegel, *op. cit.*, p. 656.

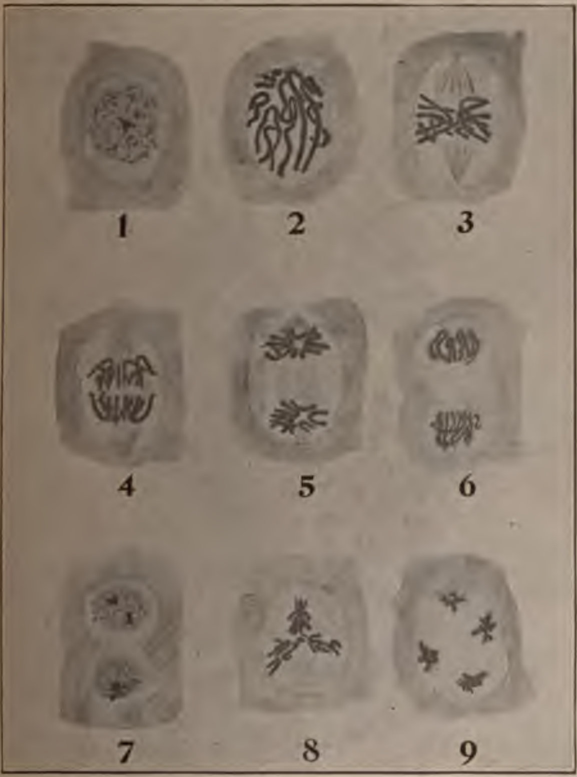

FIG. 1.—Diagrammatic representation of Nucleus undergoing Kariokinesis.

[*To face p.* 42

form the daughter stars or diaster shown at 5. The threads then become thicker and assume the spirem form, and we have the double spirem, 6. The cell now divides, and they subside into resting nuclei, 7.

Boveri's description of the process is an admirable statement of the whole process in a few words:—

"The collection of the chromatic nuclear material in a definite number of isolated parts of characteristic form varying with the kind of cell—the chromatic elements. The formation of an achromatic figure of threads, either from the nucleus or from the cell substance, with two poles. The arrangement of the chromatic elements as far as their number, size, and form allow in the equatorial plane of the achromatic figure. The division of the chromatic elements into two halves, of which one half goes to either pole. The transformation of the daughter elements into the network of the new nuclei." *

The importance to us of the study of kariokinesis lies in the fact that in sarcoma and cancer we frequently find atypical mitoses. According to the valuable researches of Hemmeter,† the abnormality in the mitotic process is due to alteration in the nutrition of the cell, this in turn being due either to alterations in the local blood supply or to the fact that the cells are growing in an un-

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* Boveri, "Zellenstudien," heft. 1, "Die Bildung der Richtungskorper bei Ascaris megalocephala und Ascaris lumbricoides." Jenaische, "Zeitschrift fur Med. Naturwissensch," band. xxi., 1887.

† Hemmeter, "Histologic Studies relating to the Early Diagnosis of Carcinoma of the Stomach," *Philadelphia Med. Journal*, February 3, 1900,

favourable environment of toxines. We may group cases of irregular mitosis as follows:—

1. Cases where the chromasomes are abnormally few. These forms are termed hypochromatic, and may be due to loss of chromasomes or asymmetrical division.

2. Hyperchromatic forms where the number of chromasomes is increased.

3. Variations in the shape of the chromasomes, which instead of being rod-like, may assume a globular or biscuit shape.

4. Variations in division.

(*a*) The division of the nucleus may not correspond with metakinesis. That is to say, that the process of kinesis may have taken place and the daughter nuclei formed without any corresponding division of the cell nucleus.

(*b*) The spirem may divide into more than two parts.

(*c*) The division may be absolutely asymmetrical, a greater number of chromasomes going to the one pole than to the other.

A diagram of nuclei undergoing common forms of irregular mitosis is shown in Fig. 1 at 8 and 9.

An important point to bear in mind is that the cells in any tissue of the human body have a mode of division peculiar to such tissue. From this it will follow that if in any tissue we find cells which are undergoing kariokinesis in a different manner to the normal cells in that tissue, there is a strong probability that they are strangers and have invaded that tissue from without. And if in addition we find that the tendency to reproduction in these intruding cells is so strong that—not content with the ordinary division into two—three or more poles are developed, the grounds for suspecting malignancy will be very great.

THE EXAMINATION OF THE ABDOMEN FOR TUMOURS.

By Palpation.—It is needless to remark that in every case of suspected or possible malignant disease of the stomach we should make a very careful search for a neoplasm. There can be no possible doubt that the reason we find in so many reports of malignant disease of the stomach that no tumour could be discovered during life is that the patient had not been subjected to a thorough examination by modern methods. From the single examination by palpation only, in our consulting room, of a patient unprepared by preliminary catharsis or lavage of the bowels, we cannot probably learn anything which will justify us in expressing a definite opinion as to the absence of a tumour in the abdomen. If we find one, well and good, but even then a more careful examination will be necessary to make out its exact position and relations. If we fail to find one, we cannot say that none is present, as our examination has not been an adequate one. When so much is at stake neither the patient nor the physician should grudge the time and trouble necessary for an examination conducted under such circumstances as to give a reliable result.

Such an examination should be conducted upon the following lines.

In the first place the patient should have been prepared by free catharsis and a few high injections of hot water. By these means we clear out any scybalous masses from the colon which might possibly mislead us. The next point to observe is that the patient should be completely undressed and in bed. For many reasons it is advisable whenever it can be managed for the patient to enter a nursing home for a couple of days. We can under these circumstances ensure a proper lavage of the bowels and efficient assistance during the examination. We then proceed to palpate the abdomen of the patient, first whilst in the recumbent position and afterwards in the knee-chest position. In any case, whether we discover a tumour or not, the next step will be the inflation of the stomach by one of the usual methods. If a tumour has been found we shall acquire much additional information with regard to its relations by inflation of the stomach, and in many cases where we have failed to find one on simple palpation it will be brought up into view.

In many cases unfortunately the rigidity of the abdominal muscles so often met with in cases of malignant disease of the stomach will entirely prevent us from learning anything by palpation carried out in the usual manner. In such cases we may try the effect of examination of the patient whilst immersed in a hot bath or preferably may place the patient under the influence of an anæsthetic.

Palpation should always be performed under the following conditions in succession:—

1. With the stomach empty. Some tumours of the posterior wall can only be made out when this is the case.
2. With the stomach distended with air.
3. With the stomach filled with water.

In any case if a tumour is found we should always inflate the stomach and study the movements which are communicated to the mass.

Among the possible pitfalls which attend the discovery of tumours by palpation, there are two which deserve especial mention. Leube some time ago pointed out that under certain conditions it was possible to mistake the head of the pancreas for a neoplasm. In gastroptosis beyond a certain degree the pancreas will be uncovered and may easily communicate the sensation of a tumour to the hand of the examiner. This mistake may be obviated by inflation of the stomach. When this has been done it will be seen first of all that there is gastroptosis, and secondly that the tumour lies above the lesser curvature, does not move on respiration, and is not connected to the stomach in any way. The second cause of error is a lymphatic gland which Ewald states is to be found in the gastro-colic ligament opposite the centre of the greater curvature of the stomach. Under certain inflammatory conditions of the stomach this will become enlarged and tender, and as it is obviously connected to the stomach, may easily be mistaken for a tumour.

By Means of the X-Rays.—It is important to bear in mind that when viewing the projection of an internal organ with any given position of the tube there is only one spot the position of which will be correctly represented in relation to the surrounding parts. It will be that point through which a ray proceeding from the bulb will fall perpendicularly upon the screen, the screen, of course, being supposed to be accurately placed in a position parallel to the long axis of the tube. The position of any opaque object situated along this ray will be accurately represented upon the screen. With the tube in this position all other shadows upon the screen will not accurately represent the true position of the internal parts by which they have been caused. The reason of this is that the rays proceeding from the tube are divergent, and will fall upon the screen at an angle. It will of necessity follow that taking the ray passing through the centre of the tube and falling perpendicularly upon the screen as a fixed point, all other projections upon the screen will be further from it than they should be, and will give only distorted representations of the bodies which have caused them. Again, if the perpendicular ray in question passes through the centre of an internal organ, the projection of the body upon the screen will make it appear larger than it really is, the apparent size increasing with the distance of the screen from that body.

Another source of error which prevents the projections of the thoracic and abdominal organs upon the fluorescent screen from presenting the sharp outlines obtained with the arms and hands, is mainly due to the thickness of the patient's body and the consequent distance of the tube from the recording surface. This fluffiness of outline appears to be due to secondary rays which proceed not only from the tube itself but also from diffuse reflexion within the body.

Fortunately both these difficulties can be practically overcome.

It is obvious, then, that to make use of the X-rays to ascertain the exact size and position of an internal organ such as the heart or stomach we must take a series of successive observations at successive points all round its margin, placing the X-ray tube in such positions that the perpendicular ray will pass through them, and marking upon the skin of the patient the spot at which the ray will emerge on its way to the screen. We shall then in this manner secure a diagram upon the skin which will truly represent the exact size of the organ beneath.

In order to accomplish this we require two things—

1. A method of ascertaining the spot upon the screen on which perpendicular rays from the tube are impinging.

2. A mechanism by which we can, whilst standing in front of the patient and looking into the screen, move the X-ray tube behind the patient into any position we require, at the same time preserving its strict parallelism to the screen.

3. A method of cutting off the peripheral rays proceeding from the tube.

The first indication is accomplished by means of Dr. Guilleminot's radioguide. This consists of a little metallic cross supported upon a stem carrying three flanges of thin metal at right angles to each other, each flange being directly under one arm of the cross. The stem carrying the cross can be brought into a position in front of the tube and perpendicular to the screen at any moment by means of a lever. When this has been done the apparatus will appear on the screen as a simple cross; the flanges not showing, as their linear shadow will correspond with that of three of the arms of the cross. In any other position the cross will not show up sharply upon the screen, its arms being broadened by the shadow cast by the flanges. When the cross shows up distinctly and sharply upon the screen, we know that its centre will correspond to the ray from the tube, which is falling perpendicularly upon the screen, and that any object at this point is correctly delineated.

The second requirement is provided for by an apparatus for holding and moving the tube as shown in Fig. 3, also designed by the same physician. This consists of an upright gallows-like framework carrying in grooves a holder for the tube, to which vertical and lateral motion in a plane parallel to the screen can be communicated by a system of cords passing over pulleys. The patient will stand with his back to this framework, supported in position by arm and body rests, and the screen is suspended in front of him by cords passing over pulleys attached to a pair of projecting arms.

As regards the remaining difficulty, we may increase the clearness of the image upon the screen to a marked degree by the use of a diaphragm placed either on the tube-holder in front of the tube or in front of the screen. Taking all things into consideration the best results appear to be obtained with the latter, which incidentally possesses the advantage of protecting the fingers of the operator against X-ray burns, as the edges of the screen at the points where he will hold it will be in shadow. One of the best diaphragms for use in front of the screen is the iris diaphragm of Dr. Beclere.* This consists of two pieces of sheet-iron, the edge of each

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* A. Beclere, "L'Emploi du Diaphragme-iris en Radioscopie et son utilite pour la determination du point d'Incidence Normale."

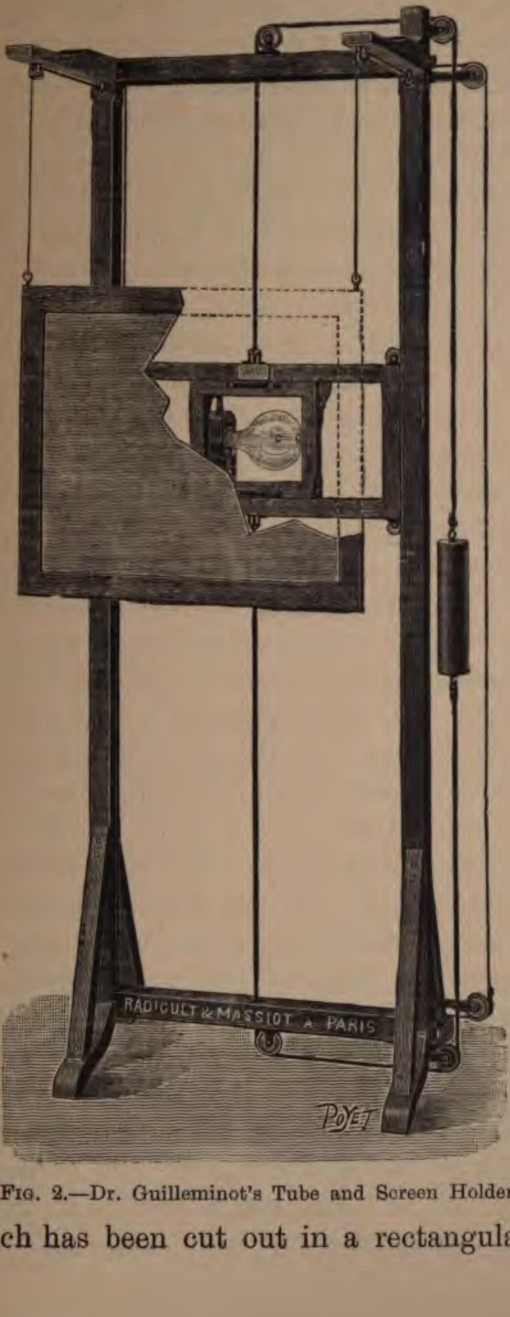

FIG. 2.—Dr. Guilleminot's Tube and Screen Holder.

of which has been cut out in a rectangular form.

As these slide over one another a varying aperture of diamond shape is produced. For use when taking skiagrams a very ingenious arrangement of diaphragms has been invented by Dr. Pasche * with which he claims to be able to obtain pictures with greatly increased clearness. It is constructed on the principle of the focal plane shutter used in photography or that used in the panoram kodak. A full description will be found in a recent journal.

An examination of the patient for the purposes we have in view will be made in the following manner: The patient stands in front of the framework, supported in position by the arm and back rests. The tube is brought opposite the centre of his back, and the screen drawn down in front. The landmark upon which we should fix our attention is the diaphragm. Upon illumining the tube this will be seen to form a dome across the body, differing in appearance upon the two sides. On the right side of the patient, together with the liver, it will form a dark shadow bounded above by a convex line corresponding to the rib. On the left side it will appear as a narrow dark band separating the clear area of the lung above from that of the stomach below. Having made this out we move by means of the cords the tube-holder until the cross of the radioguide is seen immediately below the centre of the left side of the diaphragm in the position which the stomach should occupy. If moderately distended with air the stomach will show up as a clear space of a globular form, bounded above by the diaphragm, and right and left and below by the comparative

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* Pasche, "Archives d'Électricité medicale," May, 1903.

darkness of the surrounding parts. A glance will show us whether the stomach can be distinctly made out or not. In the latter case we administer a small effervescing powder.*

This will expand the stomach, and in most cases give it a distinct outline. We may now map out upon the skin of the patient's abdomen the projection of his stomach by bringing the radioguide to successive points round its margin, as shown upon the screen, and marking them upon the skin with a dermographic pencil passed behind the screen. To avoid the necessity of placing the hands behind the screen and thus running the risk of X-ray burns, a long holder may be used which carries the pencil at right angles at its end. With a little practice this will be found quite easy to use. We may check our observation of the position of the lower margin of the stomach by administering the author's keratin-coated bismuth capsules and marking upon the abdominal wall the point at which their shadows appear upon the screen, taking care, of course, that we get the cross of the radioguide upon them whilst doing so, to avoid errors. Our next step will be to examine carefully for any dark shadow on or near the stomach area which may be a tumour. If we find such we mark its position upon the skin, and under these circumstances should certainly not omit to make a subsequent examination of the patient by palpation whilst under an anæsthetic. We complete our examination with the X-rays by examining the patient first with his side and afterwards with his abdomen towards the tube.

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* "Intragastric Technique," Formulæ 1 or 2, p. 23.

SUMMARY OF CONCLUSIONS ARRIVED AT.

It is a matter of extreme difficulty to lay down dogmatically what facts will or will not justify us in diagnosing cancer of the stomach in its early stage. This is mainly due to the fact that they will have a different practical value under different circumstances and in different individuals. It is therefore necessary to take each case separately, carefully to weigh the pros and cons, and to estimate the value of the symptoms and signs present. Symptoms which singly may have little significance, in combination may forge such a chain of circumstantial evidence as will make our opinion practically unassailable.

The following groups of associated symptoms will strongly suggest commencing cancer of the stomach:—

1. Progressive diminution of free HCl in the stomach during the digestive period, associated with loss either of appetite or of flesh, or both.
2. Progressive increase in food-stagnation and retention in the stomach with malnutrition, pyloric obstruction having been excluded by the water test.
3. Progressive anæmia and emaciation.
4. Progressive diminution in the amount of proteid digested, as shown by Hammerschlag's test.

Our position will be immensely strengthened and our diagnosis rendered practically certain by:—

A. The discovery in fragments of mucosa extracted from the stomach of—

(*a*) Direct invasion of the glandular tissues by proliferating epithelial cells which have perforated the stratum proprium.

(*b*) Cells the nuclei of which are undergoing mitosis which deviates from the forms normal to the tissue in which they are found.

(*c*) Gland tubules of atypical shape.

(*d*) Remains of gland tubules partially destroyed.

B. The discovery of colonies of lactic-acid-producing bacilli upon the stomach walls.

C. The presence in the stomach of the bacillus geniculatus in any quantity.

D. The presence of a tumour as shown by palpation or by the X-rays.

In cases where the diagnosis rests between malignant disease of the stomach and pernicious anæmia, an erythrocite count of not less than 2,000,000 per cubic millimetre will practically exclude the latter.

Whilst the onset of cancer of the stomach is usually gradual, yet in a certain number of cases the first symptoms appear to come on more or less suddenly, especially after an attack of some acute illness, such as influenza. But in most cases, as Riegel points out, if you closely question such patients you will find that they have suffered from slight symptoms of dyspepsia for some time previously. It is in these cases not improbable that the acute affection fanned into activity the smouldering malignant process.

From a close study of cancer cases it appears that hæmatemesis is usually not an early symptom, and need not be taken into consideration from a diagnostic point of view.

Another point which is useful to remember is that the appearance of the patient may present nothing abnormal in the early stage. We must therefore never exclude malignant disease on the ground that there is no cachexia. Even if present cachexia is by no means diagnostic, as it may be due to any affection of the stomach accompanied by defective digestion and assimilation of food.

In concluding this brief and incomplete sketch I would again point out that it is most important to bear in mind that often we cannot make a diagnosis from one examination alone. Patients come to our consulting room or are sent for an opinion with the expectation that by asking a few questions and palpating the abdomen we can tell them positively the nature of the complaint from which they are suffering. I am sure that my readers by this time will agree that this is impossible, and that to make a diagnosis with any degree of certainty it may be necessary to keep the case under observation for some little time. And this should present no difficulty. When it is a question to be decided whether or no a patient is suffering from malignant disease of the stomach, the issues at stake are so great and of such vital importance to him, that no one in his senses would refuse to afford the facilities necessary in order that a definite opinion may be formed of his case. Whenever possible it is far best for the patient to enter a nursing home for two or three weeks in order that he may be under the immediate observation of the physician and that the necessary examinations may be conducted under the most favourable conditions and in the best possible manner.

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